Thought Question

Jenny takes biology and chemistry courses that have different attendance policies. Her biology professor says that Jenny will lose 5 points from her final grade each time she misses class. Her chemistry professor says that Jenny will gain 5 points for each class she attends, out of a total number of points allocated for attendance as part of the final grade. How is Jenny likely to respond to these two situations and why might there be differences in her response?

Decision-making II

Heuristics and Reasoning

Estimating

- Decision making under risk involves estimating values and using the probability of various outcomes.
- Where do we get those estimates and probabilities?
  - sometimes, are given
  - more often, have to try to figure out

How do we reason about probabilities?

- Use heuristics: cognitive shortcuts
  - Useful because of resource limitations
- But…
  - Use of heuristics leads to judgment biases
- Some example heuristics:
  - anchoring & adjustment
  - representativeness
  - availability

Anchoring & Adjustment

- Strategy in which estimation begins with an initial anchor and estimate is adjusted in light of incoming information
- 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 =
- 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1 =

Anchoring & Adjustment

- 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 =
  = 512
- 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1 =
  = 2,250
- real answer=40,320

Anchoring & Adjustment

Real-world implications

- Choice of anchor very important
    - in bargaining context, price is anchor
    - in legal contexts, requested compensation

Representativeness

- Coglab activity

Representativeness

- Estimate that something is more probable if it has many features that you associate with a particular outcome.

Representativeness

Typical Example:

- Which of the following events is the most likely?
  - That a man is under 55 and has a heart attack
  - That a man has a heart attack
  - That a man smokes and has a heart attack
  - That a man is over 55 and has a heart attack

Representativeness

Typical Example:

- Which of the following events is the most likely?
  - That a man is under 55 and has a heart attack
  - That a man has a heart attack
  - That a man smokes and has a heart attack
  - That a man is over 55 and has a heart attack

- People often pick these.

Representativeness

Example:

- Which of the following events is the most likely?
  - That a man is under 55 and has a heart attack
  - That a man has a heart attack
  - That a man smokes and has a heart attack
  - That a man is over 55 and has a heart attack

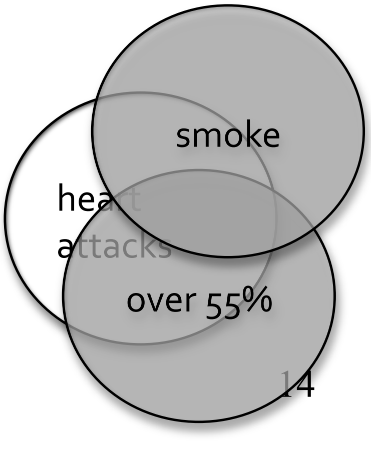
- But has to be this one.

Representativeness

- **Conjunction fallacy:**
- **Two conditions can NEVER be more probable than the probability of one of them alone.**
  - **people have heart attacks with a certain probability**
  - **OF THOSE, a high proportion may be over 55 or smoke**
  - **but probability of a heart attack overall still higher because that includes minority in other categories**

Representativeness

- **Conjunction fallacy:**
- **Two conditions can NEVER be more probable than the probability of one of them alone.**



Even if most heart attacks are in smokers over 55, most likely event is "heart attack", not "heart attack + over 55"

Representativeness

Another example

- Which of the following is the more likely outcome of a series of eight coin tosses?
- T T T T T T T T
- H T T T H H T T

- They are EQUALLY likely!

Representativeness

- T T T T T T T T
- H T T T H H T T

- Second toss has no apparent pattern and thus seems more "random".
- We know coin toss outcomes should be random, so seems more representative.
- More representative seems more probable

Availability

- Tendency to form a judgment on the basis of what's readily brought to mind.
- **Example:** how many English words fit
- _ _ _ _ n _
- _ _ _ i n g

Availability

- **Example:** how many English words fit
- _ _ _ _ n _
  - 125
- _ _ _ i n g
  - 880

Availability

Tversky & Kahneman (1974)

- If a word of three or more letters is taken randomly from a text, is it more likely that the word starts with “r” or has “r” as its 3rd letter?
  - Actually, more with “r” as third letter.
  - Most people think it is with “r” as first letter, because easier to come up with such words.

Availability

- Availability reflects the effectiveness of our search strategy
  - May or may not reflect actual probability

Pros & Cons of Availability

- Availability can arise because of higher frequency of events
  - frequency → probability
- But other things can increase availability
  - recency
  - publicity
  - distinctiveness

Solo Members

Group A	Tape	Group B
5 Caucasians	6 voices	3 Caucasians
1 Hispanic		3 Hispanics

- Statements attributed to the Hispanic remembered better in group A than group B.
- Statements attributed to the Hispanic were more negatively evaluated in group A than B.

Solo Members

- Statements attributed to the Hispanic were more negatively evaluated in group A than B.
- Why?
- Behaviors of "Hispanic" individuals were less frequent in group A and thus more distinctive.
- *Negative* behaviors of "Hispanic" individuals were also more unlikely and more distinctive.
- More distinctive = more available = estimated to be more probable

More Biases

- **Have been talking about information that people pay attention to.**
- **There is also information that people tend to ignore.**

Example

A certain town is served by two hospitals. In the larger hospital about 45 babies are born each day. In the smaller hospital about 15 babies are born each day. About 50% of all babies are boys. However, the exact percentage varies from day to day. Sometimes it is higher than 50% and sometimes lower. For one year, both hospitals recorded the days on which more than 60% of the babies born were boys. Which hospital do you think recorded more such days?

- the larger hospital
- the smaller hospital
- about the same (within 5% of one another)

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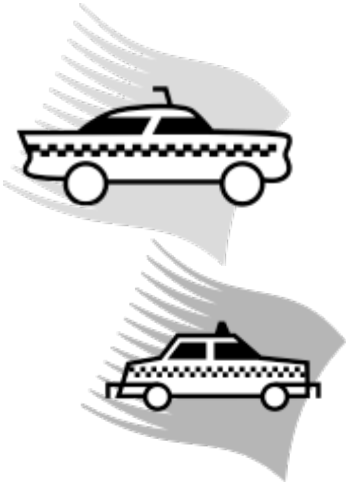
- the larger hospital
- the smaller hospital
- about the same (within 5% of one another)

Ignoring sample size

- Smaller samples are more likely to deviate from the average.
  - two coin tosses, both heads?
  - 100 coin tosses, all heads?

Another example



- In a certain city, 85% of cabs are green and 15% are blue.
- A cab is involved in a hit and run accident.
- A witness reports that the cab was blue.
- Witness's vision is tested and she is 80% accurate at identifying colors.
- What's the probability that the cab in the accident was blue?

Another example

- In a certain city, 85% of cabs are green and 15% are blue.
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- What's the probability that the cab in the accident was blue?

- **Most people estimate ~80%.**
- **Actual probability is ~40%.**

Ignoring base rate

- Base rate: frequency of event in a pool of events.
- Out of 100 cabs . . .
  - 85 are green
    - of those, witness says 20% (17) are blue
  - 15 are blue
    - of those, witness says 80% (12) are blue
  - Of times that witness would report a blue cab, 12/29 = 41% were actually blue.

Ignoring base rate

- Implications: medical diagnosis.
- All tests have some probability of false positives.
  - test says that disease is present when it is not
- If base rate of actual disease is low, likely to have more false positives than correct diagnoses.

Ignoring base rate

- The probability of breast cancer is 1% for a woman at age 40 who participates in routine screening. If a woman has breast cancer, the probability is 92% that she will get a positive mammography. If a woman does not have breast cancer, the probability is 12% that she will get a positive mammography. A woman in this age group had a positive mammography in a routine screening. What is the probability that she actually has breast cancer?

Ignoring base rate

- **Assume 10,000 women take test**

	Positive	**Negative**	**Total**
Cancer			
No Cancer			
Total			**10,000**

Ignoring base rate

- **Assume 10,000 women take test**
  - ☐ 100/10,000 = 1% actually have cancer

	Positive	**Negative**	**Total**
Cancer			**100**
No Cancer			**9900**
Total			10,000

Ignoring base rate

- **Assume 10,000 women take test**
- 100/10,000 = 1% actually have cancer
- Of women who DO NOT have cancer (9,900 total)
  - 88% (8,712) test negative
  - 12% (1,188) test positive

	Positive	Negative	Total
Cancer			100
No Cancer	**1188**	**8712**	9900
Total			10,000

Ignoring base rate

- **Assume 10,000 women take test**
- 100/10,000 = 1% actually have cancer
- Of women who DO NOT have cancer (9,900 total)
  - 88% (8,712) test negative
  - 12% (1,188) test positive

	Positive	Negative	Total
Cancer	**92**	**8**	100
No Cancer	1188	8712	9900
Total			10,000

- Of women who DO have cancer (100 total)
  - 92% (92) test positive
  - 8% (8) test negative

Ignoring base rate

- **Assume 10,000 women take test**
- 100/10,000 = 1% actually have cancer
- Of women who DO NOT have cancer (9,900 total)
  - 88% (8,712) test negative
  - 12% (1,188) test positive

	Positive	Negative	Total
Cancer	**92**	8	100
No Cancer	1188	8712	9900
Total	**1280**	8720	10,000

- Of women who DO have cancer (100 total)
  - 92% (92) test positive
  - 8% (8) test negative
- Of women getting a positive test (1188 + 92 = 1280):
  - 92/1280 = 0.07
  - ONLY 7% HAVE CANCER!

Summary

- **People use shortcuts when making decisions.**
- **These shortcuts create biases.**
- **Heuristics**
  - **anchoring and adjustment**
  - **representativeness**
  - **availability**
- **Ignored information**
  - **sample size**
  - **base rate**

Reasoning

- Given some information, decide what else is true.
- Two kinds: deductive and inductive
  - inductive reasoning takes an example or small set of examples and infers what might be true of the group
  - deductive reasoning takes general principles and determines what must follow from them

Deductive reasoning

- LOGIC:
  - formal system that gives us rules for determining truth of conclusions based on a set of premises
- Do people reason logically?
- Do they reason consistently?

Logic: definitions

- PREMISE: something we assume to be true
  - If the professor comes to class, there will be a lecture.
  - The professor is in class today.
- CONCLUSION: something we derive from the premises
  - Therefore, there will be a lecture today.

Logic: definitions

- ANTECEDENT: the "if" part of a premise
  - If the professor comes to class, there will be a lecture.
- CONSEQUENT: the "then" part of a premise
  - If the professor comes to class, there will be a lecture.

An example

- "If this item is an apple, then it is a fruit."
- If we assume this to be true, what kind of conclusions can we draw?

An example

- "If this item is an apple, then it is a fruit."
- AFFIRMING THE ANTECENDENT
  - "This item is an apple"
  - "Therefore, this item is a fruit."
  - OKAY?
- Yes, affirming the antecedent is *valid*.

An example

- "If this item is an apple, then it is a fruit."
- AFFIRMING THE CONSEQUENT
  - "This item is a fruit"
  - "Therefore, this item is an apple"
  - OKAY?
- NO! Could be a pear . . .
- Affirming the consequent is *invalid*.

An example

- "If this item is an apple, then it is a fruit."
- DENYING THE ANTECEDENT
  - "This item is a not an apple"
  - "Therefore, this item is not a fruit"
  - OKAY?
- NO! Again, could be a pear . . .
- Denying the antecedent is *invalid*.

An example

- **"If this item is an apple, then it is a fruit."**
- **DENYING THE CONSEQUENT**
  - **"This item is a not a fruit"**
  - **"Therefore, this item is not an apple"**
  - **OKAY?**
- **Yes, denying the consequent is *valid*.**

Too abstract?

- **May seem like this is very abstract, but we do things like this all the time. Test yourself on the following:**
- **If Mary likes me, then she will smile at me. Mary smiled at me! Therefore, she likes me.**
- **BEEP! Affirming the consequent**

Too abstract?

- If I am a freshman, then I need to register for classes tomorrow. I am not a freshman. Therefore, I do not need to register for classes tomorrow.
- BEEP! Denying the antecedent

Using deductive reasoning

- Hypothesis testing: If X is true, then Y . . .
- Test to find out.

Wason Selection Task

E	4	7	F

RULE: If a card has a vowel on one side, it has an even number on the other.

Which cards MUST I turn over to be sure that my rule is being followed?

Wason Selection Task

beer	22	17	pepsi

Another example.

RULE: If a person is drinking alcohol, then they must be at least 21.

Which of these individuals MUST I check to make sure my rule is being followed?

Wason Selection Task

E	4	7	F

RULE: If a card has a vowel on one side, it has an even number on the other.

Which cards MUST I turn over to be sure that my rule is being followed?

50% E

46% E & 4

4% E&7

Wason Selection Task

E	4	7	F

RULE: If a card has a vowel on one side, it has an even number on the other.

Which cards MUST I turn over to be sure that my rule is being followed?

50% E

46% E & 4

4% E&7 <- correct answer

Wason Selection Task

E	4	7	F

RULE: If a card has a vowel on one side, it has an even number on the other.

Logic tells us that affirming the antecedent should be true (check E) and that denying the consequent should be true (check 7).

Confirmation bias: tendency to look for evidence that confirms our hypothesis rather than falsifying evidence.

Wason Selection Task

beer	22	17	pepsi

RULE: If a person is drinking alcohol, then they must be at least 21.

Which of these individuals MUST I check to make sure my rule is being followed?

Now most people get it right! Must check beer drinker and 17 year old.

Wason Selection Task

beer	22	17	pepsi
E	4	7	F

These are the SAME logical problems.

People and logic

- People have difficulty applying rules of logic in everyday reasoning.
- Again, see framing effects – sometimes people apply logic and sometimes not.

Summary

- Instead of reasoning logically, people seem to apply schemas, based on their experience.
- These schemas may differ for problems framed in different ways.
  - matching schema/confirmation bias
  - cheating schema

Question

At a doctor's visit you are told that you have tested positive for a rare kidney disease. The doctor tells you that the test is very accurate and that more than 99% of people with the disease test positive. He suggests you immediately begin a course of treatment, which should cure the disease but has some serious side-effects. Before agreeing to the treatment, what additional information do you want to get from the doctor?